Hydroponics Technology for Horticultural Crops

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Providing quality nutritive food to more than 1.6 billion people by the Year 2025 would be a major challenge for the country. Increasing population, decreasing land and water holding, urbanization, industrialization, global warming are some of the major impediments for the country. Various biotic and abiotic stress factors are threatening the open field agricultural production systems throughout the world in varying degrees. The soil fertility status has attained almost the saturation level in most parts of the country as the productivity is not rising pro rata with the amount of inputs.

Hydroponics refers to cultivation of plants without soil, either in water or based on various soil-less media. Utilizing this technology, the roots absorb balanced nutrients dissolved in water that meet all the developmental requirements of plants. The word hydroponics was derived from the Greek words, HYDRO (water), and PONOS (labour), literally "water working". Protected Hydroponics cultivation technology including greenhouse production systems require adherence to GAP protocols because intensive cultivation in greenhouses often involves excessive use of chemicals since the stakes are high due to intensive inputs and high expectations on quality front.

Hydroponics cultivation has great prospects for Indian agriculture. It is one of the potential technologies for doubling farmers income. In the changing scenario of food habits and growing fad for green vegetables, herbs and fruits, hydroponics technology is going to play a major role for sustainable and round the year production in urban and peri-urban areas.

The impact of desertification and climate change requires aquaponics to ensure food security. Aquaponics has been identified as a farming approach that, through nutrient and waste recycling, a solution for sustainable development goals, particularly for arid regions while energy saving and higher growth rates through increased CO_2 levels in the crop environment are advantageous in moderate climate zones. Traditional aquaponics designs comprise of aquaculture and hydroponic units involving recirculating water between both subsystems. In such one-loop aquaponics systems, it is necessary to make trade-off conditions of both subsystems in terms of pH, temperature, and nutrient concentrations as fish and plants share one ecosystem. Secondly in decoupled dual-loop aquaponics systems separate the recirculated aquaculture system (RAS) and hydroponic units from one another, creating detached ecosystems with inherent advantages for both plants and fish. Recently, there has been an increased interest in closing the loop in terms of nutrients as well as increasing the input/output efficiency. For that reason, remineralization and distillation loop have been incorporated into the overall system design to form multi-loop aquaponic systems (Goddek and Körner, 2019).

Aquaponics is an integrated system that links hydroponic plant production with recirculating aquaculture. Aquaponics systems use resources and energy more efficiently than single production systems, thus facilitating sustainable and environmentally friendly food production. Recirculating aquaculture systems (RASs) are systems that treat and reuse the wastewater from fish farming. In an aquaponics system, fish wastewater from a recirculating aquaculture system is delivered to hydroponics systems. In a recirculating aquaculture system, ammonia and nitrite produced from the residual bait and faeces of fish are the major metabolic wastes that harm the growth of fish. Nitrification

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through biological filters converts NH_4 into NO_3 via NO_2, and NO_3 is an excellent fertilizer for plants. This process can purify fish wastewater, and then the water is recycled back to the aquaculture system. Recycling of the aquaculture water for plants saves water and nutrients (Ren et al., 2018).

References

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